

The Major Foodborne Illnesses And How to Control Them

Botulism

In the United States an average of 110 cases of botulism are reported each year. Although rare, botulism is a public health concern because it can be fatal if untreated. *Clostridium botulinum*, the bacterium linked to the disease, exists in soil, water, honey, feed, manure and sewage, on fruits, vegetables and other plants, and in the intestinal tracts of animals and fish.

The pathogen produces spores that can contaminate raw foods during production, harvesting or processing. If the foods are improperly processed, the spores will germinate, grow and produce a toxin in the food. This toxin affects the nervous system and can contribute to death even in small amounts.

Preferring an oxygen-free environment, botulism is usually associated with low-acid canned foods that have been improperly processed, stored or consumed without proper heating. The toxin can be rendered harmless by boiling food for at least 10 minutes.

Most botulism outbreaks have been traced to home-canned foods. The foods involved in a majority of these outbreaks include:

- Low-acid canned vegetables, such as green beans, corn, spinach, beets, asparagus, peppers, pimentos and mushrooms.
- Fish and fish products, such as fermented or smoked fish and fish eggs that are vacuum-packed.
- Home-canned fruits and vegetables.
- Condiments, such as chili peppers, tomato relish, chili sauce and salad dressing.

Meat, poultry and dairy products have rarely been associated with botulism, although several outbreaks have been attributed to improperly handled baked potatoes wrapped in aluminum foil, sautéed onions, garlic-in-oil mixtures, potato salad and pot pies. In each case, the foods were cooked and held at temperatures that allowed the bacteria to grow before the meal was served.

Symptoms

Botulism can develop within two hours to 14 days of ingesting contaminated food, but symptoms usually appear within 18 to 36 hours. In general, the shorter the incubation period, the more severe the disease and the higher the fatality rate.

Food Marketing Institute (FMI) conducts programs in research, education, industry relations and public affairs on behalf of its 1,500 member companies — food retailers and wholesalers — in the United States and around the world. FMI's U.S. members operate approximately 26,000 retail food stores with a combined annual sales volume of \$340 billion — three-quarters of all food retail store sales in the United States. FMI's retail membership is composed of large multi-store chains, regional firms and independent supermarkets. Its international membership includes 200 companies from 50 countries.



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The most common symptoms are gastrointestinal disturbances, sometimes followed by nausea, vomiting and possibly diarrhea. Blurred or double vision and difficulty in swallowing and speaking are also common symptoms. Drooping eyelids, fatigue, weakness, dizziness, headache and constipation may occur. Certain muscles become paralyzed, and the paralysis eventually spreads to the respiratory system and heart. Death usually is caused by respiratory failure.

Prevention

Botulism can be prevented by strictly following safe, approved and up-to-date methods for canning foods and by thoroughly heating them (boiling for 10 to 15 minutes) just before serving. All cooked foods should be held at temperatures higher than 140°F (60°C) and rapidly cooled to 40°F (4°C) or below and kept refrigerated. Avoid leaking or bulging food containers and foods with off-odors. Do not feed raw honey to infants.

Campylobacter

Campylobacter is one of the most common bacteria linked to diarrheal illness in the U.S. This illness, campylobacteriosis, is associated with the *jejuni* serotype, which is found in the intestines of cattle, sheep, swine, ducks, chickens and turkeys. High levels of *Campylobacter* in feces may contaminate carcasses during the slaughtering process. Poultry carcasses and parts, in particular, are a major carrier. It also exists in unpasteurized milk and untreated water.

Campylobacter jejuni is relatively sensitive to oxygen environments and survives well in environments with 3-5 percent oxygen and 2-10 percent carbon dioxide. Isolation of this bacterium in a lab is somewhat difficult because the bacteria are usually present in very low numbers, and special growth conditions are required.

Symptoms

Campylobacter infections produce a diarrheal illness, in which the feces may be watery or sticky and can contain blood. The symptoms vary widely, including abdominal pain and cramping, diarrhea, fever and weakness, headache, muscle pain, dizziness and delirium. Although vomiting is not common, it occurs in some cases.

Symptoms usually appear two to five days after eating contaminated food, although a range from one to 11 days has been suggested. The duration of the illness varies, but it usually lasts from seven to 10 days. Some exposed people do not have any symptoms at all, and some may develop arthritis following campylobacteriosis.

Prevention

The growth of *Campylobacter* is inhibited by normal levels of oxygen in the air (21 percent). It grows at temperatures from 86°F to 116°F (30°C to 47°C), but grows fastest from 107°F to 113°F (42°C to 45°C). To help control it, use the following safe food-handling practices:

- Avoid consumption of unpasteurized milk and untreated water.
- Wash hands, utensils and work areas with hot, soapy water after con-

tact with raw meat and meat patties.

- Cook meat patties to an internal temperature of 160°F (71°C), and use a thermometer to confirm it has reached that level. Cook poultry items to a minimum internal temperature of 180°F (82°C) for whole birds and 170°F (77°C) for breast meat. If your microwave oven is a lower-wattage model, consumers should cook food longer or at a higher setting. Cover and rotate food for even cooking. Let food stand inside the oven after cooking if so directed. The food will finish cooking as it stands.
- Serve cooked food with clean plates and utensils.
- Never allow raw foods to contact ready-to-eat foods, as well as the utensils, dishes and serving plates.
- When eating out, send back any meat or poultry dish that does not appear thoroughly cooked.

Clostridium perfringens

Gastroenteritis is the disease associated with the *Clostridium perfringens* bacterium, which is present throughout the environment — in the soil, the intestines of animals and humans and in sewage. *Clostridium perfringens* is anaerobic, growing where there is little or no oxygen. Although the bacteria can be killed with adequate cooking, its spores can survive in normal cooking temperatures. During prolonged holding at ambient temperatures or improper cooling, the spores can germinate back into a live state, which allows the bacteria to multiply. Under ideal conditions, *Clostridium perfringens* can replicate every eight minutes. Ingestion of a large numbers can help lead to gastroenteritis linked to toxin production within the intestinal tract.

These bacteria are often found in cooked beef, turkey, gravy, dressing, stews and casseroles held too long at temperatures between 40°F and 140°F (4°C and 60°C). Meals held in this danger zone provide perfect breeding grounds.

Symptoms

The common form of *perfringens* poisoning features intense abdominal cramps and diarrhea, which begin eight to 22 hours after consumption of foods containing large numbers of the bacteria. The illness often ends within a day.

Prevention

The bacteria grow at temperatures from 43°F to 117°F (6°C to 47°C), and they grow fastest between 109°F to 117°F (43°C to 47°C). To help control it, observe the following safe food-handling practices:

- Avoid large-scale preparation of meat or legume dishes unless these dishes can be served immediately after cooking.
- Rapidly cool cooked foods and keep them refrigerated at temperatures below 40°F (4°C) to prevent the bacteria from multiplying. Rapid cooling may be facilitated by dividing large portions into

small dishes for serving, which increases the surface area, thus reducing the anaerobic conditions that promote its growth.

- Thoroughly reheat all refrigerated cooked meats and legumes to an internal temperature of 165°F before serving.

Cryptosporidium

Cryptosporidium is a parasite. The species most commonly exposed to humans and livestock is *Cryptosporidium parvum*. The parasite requires a human or animal host; the most common food animals are lambs and calves, where it grows in their intestinal lining. It is transmitted in the form of spore-like eggs (oocysts) in feces.

The disease linked to this parasite, cryptosporidiosis, is most commonly spread when its eggs are transmitted through drinking and recreational water. A 1993 outbreak in Milwaukee, WI, affected more than 400,000 people when the municipal water supply was contaminated. It is also spread person to person through the fecal-oral route by unclean hands. Epidemiological evidence suggests that the parasite may also be transmitted through milk or food carrying the eggs. Cases of cryptosporidiosis are high in childcare centers that serve food.

Symptoms

The most typical symptom is watery and foul-smelling diarrhea, which may be accompanied by abdominal pain, vomiting, fever, and loss of appetite and weight. In otherwise healthy individuals, the symptoms commonly persist from two to four days and may last up to one to four weeks. For immunocompromised persons, however, hospitalization is sometimes required and the illness can be life-threatening.

Prevention

Rigorous personal hygiene, especially hand washing, is one of the best preventive measures. *Cryptosporidium* eggs are readily destroyed by pasteurization or heating foods for five to 10 minutes at 150°-185°F (65°-85°C). Water that may be contaminated should be brought to a boil for at least one minute — whether it is used for drinking or cleaning foods that are to be served raw. Normal chlorination of drinking water has no effect on the eggs. The eggs can survive refrigeration temperatures, but can be killed when frozen below -4°F (-20°C).

Escherichia coli

Escherichia coli (*E. coli*) is a group of bacteria normally found in the intestines of warm-blooded animals, such as food animals or humans, and in water contaminated by animal or human feces. Scientists have identified more than 200 serotypes of *E. coli*, most of which are harmless or benign. Currently, four classes of *E. coli* are linked to gastroenteritis in humans: Enterotoxigenic (ETEC), Enteropathogenic (EPEC), Enteroinvasive (EIEC) and Enterhemorrhagic (EHEC). These strains are most often associated with intestinal illness or diarrhea in infants and in travelers who have consumed impure water or unpasteurized milk.

In 1982, a rare and more virulent strain, *E. coli* O157:H7, helped lead to two outbreaks of human gastrointestinal illness, resulting in death. Since then, more than 50 outbreaks of human illness in the United States have been associated with the organism. In one 1993 outbreak, four children died and more than 700 people were hospitalized after eating ground beef contaminated with *E. coli* O157:H7. *E. coli* O157:H7 illnesses have been associated with ground beef, raw milk, apple cider, alfalfa sprouts, coleslaw and water sources. Taking into account unreported cases, CDC estimates that 10,000-20,000 people are affected with *E. coli* O157:H7 each year and 200-400 die from diseases associated with the bacteria.

This pathogen can survive refrigeration and freezer storage and acidic conditions. It can multiply slowly at 44°F. Low doses can produce infections in all people, especially in infants and the elderly and immune-compromised persons. It can be a severe contaminant; the risk, however, can be reduced by proper personal hygiene (e.g., washing hands) and, especially for ground meats, by cooking products to an internal temperature of 160°F (71°C).

Symptoms

- Severe abdominal cramps, followed by watery diarrhea that often becomes bloody.
- Vomiting and nausea, often accompanied by low-grade fever.

E. coli O157:H7 can contribute to hemorrhagic colitis in humans. Complications from this illness include hemolytic uremic syndrome (HUS), kidney failure, blood-clotting disorders and anemia. HUS develops in 2-7 percent of the cases where the *E. coli* O157:H7 culture is confirmed. Symptoms of HUS usually appear within one week of developing bloody diarrhea, last from eight to 10 days and often require hospitalization. Dialysis may be required since HUS is a leading cause of kidney failure in children and the elderly. In adults, HUS may progress to thrombotic thrombocytopenic purpura (TTP), a central nervous system disease. TTP causes seizures and coma; patients often develop blood clots in the brain, which may result in death.

Prevention

The risk of illness from *E. coli* O157:H7 can be reduced through proper food preparation and personal hygiene, observing the following safe food-handling practices:

- Never thaw food on the counter or let it sit out of the refrigerator for most than two hours.
- Use refrigerated ground meat and patties in three to four days and frozen meat and patties in three to four months.
- Wash hands, utensils and work areas with hot soapy water after contact with raw meat and meat patties.
- Cook meat patties to an internal temperature of 160°F (71°C), and verify that it has reached that level with a meat thermometer. All

meat, poultry and fish should be well cooked. Consumers with low-wattage microwave ovens should cook food longer or at a higher setting. Cover and rotate food for even cooking. Let food stand inside the oven after cooking if so directed. The food will finish cooking as it stands.

- Serve cooked food with clean plates and utensils.
- Never allow raw foods to contact ready-to-eat foods, as well as the utensils, dishes and serving plates.
- When eating out, send back any meat, poultry or fish that does not appear to be thoroughly cooked.
- Wash all fresh fruits and vegetables thoroughly before consumption.
- Young, elderly and immune-compromised people should avoid consuming unpasteurized apple juice and ciders, raw sprouts and raw or partially cooked meats.
- Follow rules of personal hygiene, especially after using the bathroom or diapering infants.

Hepatitis A Virus

This virus is transmitted from person to person indirectly by contaminated food and ice, usually through sewage-contaminated shellfish, or directly by the fecal/oral route. It helps lead to the disease known as infectious hepatitis. Commonly, the virus is shed in the stools of someone infected with *Hepatitis A*, and in the process of defecating and wiping, the person acquires the virus on his hands. If the person does not properly wash his hands, the virus can be easily spread — through a handshake, for example. *Hepatitis A* virus cannot reproduce without a living host. However, this virus is unique in its capability to survive without a host, such as:

- Unaffected by stomach acid.
- Not killed by freezing temperatures.
- Can remain active in a dried form at least 1 month and 12 weeks to 10 months in water.
- Survive temperatures of 140°F (60°F) for 1 hour.

The *Hepatitis A* virus has been associated with cold cuts and sandwiches, fruits and fruit juices, milk and milk products, vegetables, salads, shellfish and ice drinks. Poor sanitation and over-crowding in institutions, housing projects, prisons and in military forces are commonly associated with *Hepatitis A* virus.

The extent to which people with HIV infection are more at risk for each of these illnesses is unknown, but some scientists believe that any infection may hasten the development of AIDS.

Symptoms

People with *Hepatitis A* can appear to be experiencing early stages of the flu, including: malaise, appetite loss, fever, nausea, abdominal discom-

fort, followed three to 10 days later by jaundice and darkened urine. Severe cases can help lead to liver damage and death. Mild forms may last one to two weeks; severe forms may last a few months. Incubation can last from 10 to 50 days; infected persons can shed the virus in their stools up to two weeks before they themselves are aware they have the disease. Many infections with *Hepatitis A* do not result in clinical diseases, especially in young children.

Prevention

Hepatitis A infections can be prevented by avoiding raw shellfish and shellfish that may have been harvested in contaminated waters. Also, vigorous wash hands after using the restroom. Other measures:

- Good sanitation and personal hygiene.
- Sanitary disposal of waste products.
- Exclude infected or exposed individuals from food handling activities.
- Vaccines are available for long-term prevention in persons two years of age and older. Immune globulin is available for short-term prevention for all ages if given within two weeks of exposure.
- *Hepatitis A* can be killed by boiling water at 185°F for one minute. However, the virus can still be spread to cooked foods if they are contaminated after cooking.

Listeriosis

This disease linked to the bacterium *Listeria monocytogenes*. Before 1967, listeriosis was considered rare in humans, but recent outbreaks have increased awareness of the hazards to public health.

Listeria monocytogenes is commonly found in soil, decaying and dead vegetation and the intestinal tracts of more than 50 domestic and wild species of birds and animals, including sheep, cattle, chickens and swine. Health officials have found *Listeria monocytogenes* in:

- Unpasteurized milk.
- Coleslaw (made from cabbage fertilized with the manure of infected sheep).
- Mexican-style cheese.
- Soft cheeses, such as brie and camembert.
- Ice cream.
- Deli meats and poultry.
- Hot dogs

Symptoms

Listeriosis usually affects pregnant women, newborns, adults over 50 and people weakened by chemotherapy, alcoholism, diabetes and cardiovascular disease. AIDS patients are 200-300 times more susceptible to listeriosis than the general public. The incubation period ranges from a few

days to three weeks. In most people, the disease is mild, sometimes with flu-like symptoms and fever. In pregnant women the bacteria may infect the fetus, causing miscarriages or premature births. The fatality rate for newborns with listeriosis ranges between 30 percent and 50 percent. Twenty percent of the estimated 2,500 listeriosis cases in the U.S. each year end in death.

Listeriosis may also lead to meningitis (inflammation of the membranes that envelop the brain and spinal cord) or encephalitis (inflammation of the brain, the spinal cord and the membranes surrounding both). Additional symptoms, if the infection spreads to the nervous system, include headache, stiff neck, confusion, loss of balance or convulsions.

Prevention

The optimum temperature for growth of *Listeria monocytogenes* is 86°F (30°C) to 98.6°F (37°C), but it can grow at temperatures as low as refrigeration temperatures 32°F (0°C). Pasteurization of milk and adequate cooking of food kills *Listeria* bacteria, reducing cases of listeriosis. To help control *Listeria monocytogenes*:

- Thoroughly cook all foods from animal sources. Cook ground meat to an internal temperature of 160°F (71°C) and poultry to an internal temperature of 180°F (82°C) for whole birds and 170°F (77°C) for breast meat. If your microwave oven is a lower-wattage model, consumers should cook food longer or at a higher setting. Cover and rotate food for even cooking. Let food stand inside the oven after cooking if so directed. The food will finish cooking as it stands.
- Do not consume unpasteurized milk.
- Maintain food at 41°F (5°C) or below, or 140°F (60°C) and above.
- Wash raw vegetables thoroughly before consuming.
- Wash hands, knives and cutting boards after handling uncooked foods.

People at high risk such as pregnant women and persons with weakened immune systems should:

- Avoid soft cheeses such as feta, Brie, Camembert, blue-veined, and Mexican-style cheese.
- Leftover foods or ready-to-eat meats such as hot dogs should be cooked until steaming hot before eating.
- Avoid lunchmeats unless they are reheated thoroughly.

Salmonellosis

This disease is associated with ingesting large numbers of any of the approximately 2,000 serotypes of *Salmonella*. It is one of the most frequently occurring foodborne illnesses in the United States, causing roughly 2-4 million cases annually.

For people with AIDS, and possibly late-stage HIV (human immunodeficiency virus), salmonellosis tends to recur and is extremely difficult to treat. They are at least 20 times more likely to develop a blood

infection that can be life-threatening.

Salmonella are common in the intestinal tracts and feces of animals. Chickens, turkeys, swine, cattle and pets are the most frequent sources of the bacteria. They also may be found on and within eggs. The foods most often associated with salmonellosis outbreaks:

- Meat and meat products, such as roast beef, meat pies, hash, sausage, ham, bacon and chili.
- Poultry.
- Milk and dairy products.
- Eggs and egg products, such as custards, cream cakes and eggnog.
- Fish.
- Meat and vegetable salads.
- Chocolate.

Symptoms

They usually appear 12 to 36 hours after ingesting the organism, but may range from six to 72 hours. The symptoms include diarrhea, abdominal cramps, frequent nausea and vomiting, headaches, mild fever, chills, dehydration and prostration. The illness usually lasts from two to six days. Deaths are uncommon except in the very young, very old and old and individuals with weakened immune systems. A small number of people infected with *Salmonella* will go on to develop pains in their joints, known as Reiter's syndrome, which can lead to chronic arthritis.

Prevention

To help control *Salmonella*:

- Thoroughly cook all foods from animal sources, including eggs. Cook meat patties to an internal temperature of 160°F (71°C) and poultry to a minimum internal temperature of 180°F (82°C) for whole birds and 170°F (77°C) for breast meat.
- Avoid consuming foods that contain raw eggs or raw unpasteurized milk.
- Maintain food at 40°F (5°C) or below, or 140°F (60°C) and above to prevent growth of *Salmonella*.
- Wash raw vegetables thoroughly before consuming.
- Wash hands, knives, and cutting boards after handling uncooked food.
- Avoid direct or indirect contact between reptiles (turtles, iguanas, other lizards, snakes) and infants or immune-compromised people.

Vibrio vulnificus

These bacteria live in coastal salt waters and can infect humans either through open wounds exposed to seawater or by eating contaminated seafood. The bacteria are most numerous during warm weather.

Symptoms

The onset is abrupt. Symptoms include chills, fever, diarrhea, abdominal pains and/or prostration. At high risk are people with liver conditions, weakened immune systems, and those with low levels of stomach acids (either as a natural condition or due to the frequent use of antacids), *Vibrio vulnificus* can infect the bloodstream causing illness with a 50 percent fatality rate.

Prevention

To help control *Vibrio vulnificus*:

- Avoid eating raw seafood or seafood from suspected contaminated waters.
- Check packaged seafood for expiration dates, cleanliness and package integrity. Buy seafood from markets supplied by state-approved sources. Avoid vendors that sell from roadside stands or the back of trucks.
- Cook shellfish (oysters, clams, mussels) thoroughly. For shellfish in the shell, boil until the shells open and continue boiling for five more minutes, or steam until the shells open and then continue cooking for nine more minutes. Boil shucked oysters (without shells) at least three minutes or fry them in oil at least 10 minutes at 375°F.
- Eat shellfish promptly after cooking and refrigerate leftovers immediately.

Yersinia

The *Yersinia* bacterium lives in water and some foods. The most important source of infection — leading to yersiniosis — may be raw or undercooked pork products since the mouths and nasal cavities of pigs can be heavily colonized by one of the pathogenic strains, *Yersinia enterocolitica*. The bacteria have also been found on household pets, such as sick puppies or kittens. Outbreaks of yersiniosis have been associated with contaminated pork chitterlings, chocolate milk and tofu.

The bacteria can spread from person to person or pet to person through the fecal-oral route, or by consuming contaminated water or food. Outbreaks of yersiniosis are relatively rare. Infants, children, the elderly and people with compromised immune systems are most susceptible.

Symptoms

Onset of the disease usually takes 24 to 48 hours after consuming the organism, but may take up to seven days. It may be transmitted to others as long as symptoms exist, usually two to three weeks. Symptoms include acute watery diarrhea, fever, headaches and vomiting. *Yersinia* infections sometimes mimic symptoms of appendicitis, resulting in the performance of unneeded appendectomies.

Prevention

- Wash hands before handling and eating food, especially raw pork, and after contacting animals.
- Prepare meat and other foods in a sanitary manner.
- Consume only pasteurized milk.
- Protect water supplies from animal and human feces.
- Dispose of dog and cat feces in a sanitary manner.

